SOILS INVESTIGATION

WAIPAHU NANI SUBDIVISION

WAIPIO, EWA, OAHU, HAWAII

TMK: 9-4-36-41

for

DAVID LYUM REALTY

May 11, 1973

W.O. 172

ERNEST K. HIRATA & ASSOCIATES, INC.

ERNEST K. HIRATA & ASSOCIATES, INC.
Soils and Foundation Engineering
1157 South King Street • Honolulu, Hawaii 96814 • Phone 531-5733

May 11, 1973
W.O. 172

David Lyum Realty
Room 9
1111 Union Street
Honolulu, Hawaii 96813

Attention: Mr. David Lyum

Gentlemen:

Our report "Soils Investigation, Waipahu Nani Subdivision, Waipio, Ewa, Oahu, Hawaii, TMK: 9-4-36-41", dated May 11, 1973 is enclosed. This is the report requested by you and planned in cooperation with Fukunaga & Associates, Inc., Civil Engineers.

In general, the surface soils consisted of fill ranging in thickness from zero to 9.5 feet below existing ground. Underlying the fill was a black organic clayey silt in a soft to firm condition.

Most of the fill was found to be stiff. However the fill in exploratory borings 6 and 8 indicated that the fill was loose to firm. Consolidation test results indicate a high potential for settlement. We therefore recommend that the upper five feet of fill be removed and recompacted to a minimum of 90% relative compaction. The exact limits of removal and recompaction can be determined during grading operations.

Recommendations are enclosed in this report for the general development of the subdivision.

We appreciate this opportunity to be of service. Should you have any questions, please feel free to call on us.

Very truly yours,

Ernest K. Hirata & Associates, Inc.

Ernest K. Hirata

Ernest K. Hirata

EKH:gk

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SOILS INVESTIGATION
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INTRODUCTION

This report presents the results of our soils investigation conducted on the subject property. The purpose of this investigation was to determine the general soil conditions existing on the site, to ascertain their engineering properties and to provide general recommendations for the development of the proposed subdivision.

The scope of this investigation was planned in cooperation with personnel of Fukunaga & Associates, Inc., Civil Engineers.

This investigation included drilling nine exploratory test borings, obtaining representative soil samples, laboratory testing and analysis, and the preparation of this report. A grading plan showing the area covered by this report and the approximate location of borings is enclosed in the Appendix.

SITE DESCRIPTION

The subject property is located directly north of the Pearl Harbor Middle Loch, between the Pearl City and Waipio Peninsula.

The subject property fronts on Kahuanani Street and lies between Kahuanui Street and Farrington Highway.

Topographically, the site was found to be relatively flat. The site slopes from the northeast to southwest with an average slope gradient of approximately two percent.

Several wood frame dwellings, sheds, and quonset huts were observed along the property line. A light to moderate growth of grass was observed over the entire site.

PROPOSED DEVELOPMENT

The proposed subdivision will include 37 residential lots on approximately 5.3 acres. A 44 foot wide road is proposed connecting Kahuamo Street with Kahuanani Street. Two other smaller roads are planned ending in cul-de-sacs to provide access to the remainder of the subdivision. Maximum cut and fill slopes will be approximately 5 feet. Sewers are planned for the proposed subdivision.

FIELD EXPLORATION

Field exploration was performed on April 11 and 12, 1973, by drilling nine exploratory borings with a truck mounted drill rig. Borings ranged in depth from 10 to 15 feet. The soils were continuously logged by our field engineer and classified by visual examination in accordance with the Unified Soil Classification System.

Undisturbed and bag samples were recovered from the borings for laboratory testing. Undisturbed samples were obtained by driving a thin-walled steel sampler with a 140 pound hammer from a height of 30 inches. The required blow count for each 6 inches of penetration is shown on the enclosed Boring Logs.

SOIL CONDITIONS

In general, the soil conditions over the site can be divided into two areas. The lower portions of the site, including the central and southwestern portions, were found to consist of fill ranging in thickness from 4.5 to 9.5 feet below existing ground. The fill consisted of a reddish brown to brown clayey silt in a stiff condition. Underlying the fill was a black organic clayey silt in a soft to firm condition.

The upper area demarcated by the proposed extension of Kahuamo Street and Road B consisted of a surface layer of fill ranging in thickness from zero to three feet. Underlying the fill was a brown to gray clayey silt in a firm to stiff condition down to the depths drilled.

Groundwater was found to range in elevation from +11 to +5 above sea level. The various levels encountered in the exploratory borings indicate a general flow of water from the northern to southern boundaries.

LABORATORY TESTING

Laboratory testing was performed on the undisturbed and bag samples. Laboratory tests included Atterburg Limits, moisture density relationships, shears, consolidations, compactions, swells, and CBR test. Test results and sampling procedures are described in the attached Appendix.

ENGINEERING ANALYSIS

I. Slope Stability

Laboratory test results indicate that the strength characteristics of the onsite soils will allow cut and fill slope gradients of 2:1 (horizontal to vertical).

II. Groundwater

Groundwater was encountered in borings 1, 3, 6, 7, 8, and 9 varying between elevation +11 and +5. However since the subject area is relatively flat, the need for subdrains is not anticipated.

III. Bearing Capacity

An allowable bearing pressure of 2000 PSF may be used for footings having a minimum width of 12 inches and a minimum embedment of 12 inches in both cut and fill.

IV. Lateral Pressures

An equivalent fluid pressure of 30 pounds per cubic foot per foot of depth may be used in the design of retaining walls with level surcharge.

Resistance to lateral loading may be provided by friction acting at the base of foundations and by passive earth pressure.

An allowable coefficient of friction of 0.3 may be used with the dead load forces. Passive earth pressure may be computed as an equivalent fluid having a density of 300 pounds per cubic foot. When combining passive and friction for lateral resistance, the passive component should be reduced by one-third.

V. Settlement of Fills and Foundations

Boring 6 indicated that the fill was loose to firm. Consolidation test results indicate a high potential settlement and we therefore recommend that the upper five feet of soil be removed and recompacted. The area in question can be demarcated by the proposed Roads "A", "B" and the extension of Kahuamo Street. The exact limits of removal and recompaction can be determined more accurately during grading operations.

Consolidation test results from boring 8 also indicate a high potential settlement. We recommend removal and recompaction of the existing fill.

VI. Expansive Soils

The onsite soils were found to be slight to moderately expansive. We recommend that a six inch layer of crushed rock be placed beneath all concrete slabs. Prior to

placement of concrete, the ground surface should be thoroughly wetted to minimize the potential expansion.

VII. Pipe Bedding

Due to the compressibility of the black organic clayey silt encountered beneath the fill, we recommend that a concrete cradle be used in the support of the sewer utilities.

VIII. Grading

A. Rippability: The onsite soils encountered during our investigation indicate that excavations can be made with conventional earth moving equipment.

B. Insitu Moisture Content: The average insitu moisture content of the surface soils was below the optimum moisture content. The onsite soils will probably not need to be air dried to achieve proper compaction.

C. Embankment Shrinkage: We expect a shrinkage of borrow soil due to compaction of approximately 3%. In the areas where vegatation is encountered, approximately the upper 2 inches of soil can be expected to be lost during grubbing operations.

IX. Pavement Design

We recommend that the following pavement section be considered in the design of the roadway.

2"	Asphaltic Concrete
6"	Base Course CBR 85%
6"	Select Borrow Sub-base 95% Compaction
6"	Prepared Subgrade 95% Compaction Scarified in upper 6" and recompacted

CONCLUSIONS AND RECOMMENDATIONS

1. The site is feasible for the proposed residential development.

2. Cut and fill slopes should be stable at slope gradients of 2:1 (horizontal to vertical). All slopes should be planted as soon as possible upon completion of grading.

3. Groundwater was encountered, ranging between elevation +11 and +5, however since the site is relatively flat the need for subdrains is not anticipated.

4. An allowable bearing pressure of 2000 PSF may be used for footings having a minimum width of 12 inches and a minimum embedment of 12 inches in both cut and fill.

5. An equivalent fluid pressure of 30 pounds per cubic foot per foot of depth may be used in the design of retaining walls with level surcharge.

   Resistance to lateral loading may be provided by friction acting at the base of foundations and by passive earth pressure. An allowable coefficient of friction of 0.3 may be used with the dead load forces. Passive earth pressure may be computed as an equivalent fluid having a density of 300 pounds per cubic foot. When combining passive and friction for lateral resistance, the passive component should be reduced by one-third.

6. Borings 6 and 8 indicate a high potential settlement in the existing fill. We therefore recommend that the fill around these two borings be removed and recompacted. The exact limits of removal can be determined more accurately during grading operations.

7. The onsite soils are considered slight to moderately expansive. We recommend that a six inch layer of crushed rock be placed beneath all concrete slabs. Prior to placement of concrete, the ground surface should be thoroughly wetted to minimize the potential expansion.

8. Due to the compressibility of the black organic clayey silt encountered beneath the fill, we recommend that a concrete cradle be used in the support of the sewer utilities.

9. The onsite soils can be excavated with conventional earth moving equipment. Air drying will not be necessary to obtain proper compaction. We expect a shrinkage of borrow soil due to compaction of approximately 3%. The upper 2 inches of soil can be expected to be lost during grubbing operations.

10. All fill shall be compacted to a minimum of 90% relative compaction as determined by the Modified ASSHO Test T-180.

11. All trees, roots, brush and other deleterious materials shall be removed and wasted from the site prior to placement of fill.

12. Areas to receive fill shall be scarified, mixed, blended and compacted to at least 90% relative compaction to a depth of 6 inches prior to placing of fill.

13. Our standard grading specifications are enclosed in the Appendix and shall be considered a part of this report.

14. We recommend that the pavement section as shown on page 8 be used for design of all pavement sections.

Respectfully submitted,

Ernest K. Hirata & Associates, Inc.

Ernest K. Hirata

Ernest K. Hirata P.E. 2732

EKH:gk

APPENDIX OF LABORATORY TESTING

Classification

The field classification is verified in the laboratory, also in accordance with the Unified Soil Classification System. Laboratory classification is determined by both visual examination and Atterburg Limit Tests according to ASTM D423 and D424. The final classification is shown on the Boring Logs.

Moisture-Density

The field moisture content and dry unit weight are determined for each of the undisturbed soil samples. The information is useful in providing a gross picture of the soil consistency between borings and any local variations. The dry unit weight is determined in pounds per cubic foot while the moisture content is determined as a percentage of the dry unit weight. These samples are obtained from a 3" O.D. split tube sampler.

Consolidation

Settlement predictions of the soil's behavior under load are made on the basis of the consolidation tests. Loads are applied in several increments in a geometric progression, and the resulting deformations are recorded at selected time intervals. Porous stones are placed in contact with the top and bottom of each specimen having an inside diameter of 2.40 inches and a height of 1 inch to permit addition and

release of pore fluid. Results of undisturbed and remolded samples are plotted on the Consolidation Test Report.

Compaction Tests

Compaction tests were performed on bag samples to determine the optimum moisture content at which each type of proposed fill material compacts to 100% density. The tests were performed according to the Modified AASHO T-180.

Swell Tests

Swell tests were performed to determine the expansiveness of the onsite surface soils. The tests were performed on undisturbed ring and remolded samples taking a one inch high specimen under different surcharge loads.

Shear Tests

Shear tests are performed in the Direct Shear Machine which is of the strain control type. The rate of deformation is approximately 0.03 inches per minute. Each sample is sheared under varying confining loads in order to determine the Coulomb shear strength parameters, cohesion and angle of internal friction. Eighty percent of the ultimate value is taken to determine the shear strength parameters.

ERNEST K. HIRATA & ASSOCIATES INC.

STANDARD GRADING SPECIFICATIONS

These specifications present the usual and minimum requirements for grading operations performed under the control of Ernest K. Hirata & Associates Inc.

No deviation from these specifications will be allowed, except where specifically superseded in the preliminary soils report, or in other written communication signed by the Soils Engineer.

I. GENERAL

A. The Soils Engineer is the Owner's or Builder's representative on the project. For the purpose of these specifications, supervision by the Soils Engineer includes that inspection performed by any person or persons employed by, and responsible to, the licensed Civil Engineer signing the soils report.

B. All clearing, site preparation or earthwork performed on the project shall be conducted by the Contractor under the supervision of the Soils Engineer.

C. It is the Contractor's responsibility to prepare the ground surface to receive the fills to the satisfaction of the Soils Engineer and to place, spread, mix, water and compact the fill in accordance with the specifications of the Soils Engineer. The Contractor shall also remove all material considered unsatisfactory by the Soils Engineer.

D. It is also the Contractor's responsibility to have suitable and sufficient compaction equipment on the job site to handle the amount of fill being placed. If necessary, excavation equipment will be shut down to permit completion of compaction. Sufficient watering apparatus will also be provided by the Contractor, with due consideration for the fill material, rate of placement and time of year.

E. A final report shall be issued by the Soils Engineer attesting to the Contractor's conformance with these specifications.

II. SITE PREPARATION

A. All vegetation and deleterious material such as rubbish shall be disposed of offsite. This removal must be concluded prior to placing fill.

B. Soil, alluvium or rock materials determined by the Soils Engineer as being unsuitable for placement in compacted fills shall be removed and wasted from the site. Any material incorporated as a part of a compacted fill must be approved by the Soils Engineer.

C. After the ground surface to receive fill has been cleared, it shall be scarified, disced or bladed by the Contractor until it is uniform and free from ruts, hollows, hummocks or other uneven features which may prevent uniform compaction.

The scarified ground surface shall then be brought to optimum moisture, mixed as required, and compacted as specified. If the scarified zone is greater than twelve inches in depth, the excess shall be removed and placed in lifts restricted to six inches.

Prior to placing fill, the ground surface to receive fill shall be inspected, tested and approved by the Soils Engineer.

D. Any underground structures such as cesspools, cisterns, tunnels, septic tanks, wells, pipelines or others not located prior to grading are to be removed or treated in a manner prescribed by the Soils Engineer.

III. COMPACTED FILLS

A. Any material imported or excavated on the property may be utilized in the fill, provided each material has been determined to be suitable by the Soils Engineer. Roots, tree branches and other matter missed during clearing shall be removed from the fill as directed by the Soils Engineer.

B. Rock fragments less than six inches in diameter may be utilized in the fill, provided:

1. They are not placed in concentrated pockets.

2. There is a sufficient percentage of fine-grained material to surround the rocks.

3. The distribution of the rocks is supervised by the Soils Engineer.

C. Rocks greater than six inches in diameter shall be taken offsite, or placed in accordance with the recommendations of the Soils Engineer in areas designated as suitable for rock disposal.

D. Material that is spongy, subject to decay, or otherwise considered unsuitable shall not be used in the compacted fill.

E. Representative samples of materials to be utilized as compacted fill shall be analyzed in the laboratory by the Soils Engineer to determine their physical properties. If any material other than that previously tested is encountered during grading, the appropriate analysis of this material shall be conducted by the Soils Engineer as soon as possible.

F. Material used in the compacting process shall be evenly spread, watered, processed and compacted in thin lifts not to exceed six inches in thickness to obtain a uniformly dense layer. The fill shall be placed and compacted on a horizontal plane, unless otherwise approved by the Soils Engineer.

G. If the moisture content or relative density varies from that required by the Soils Engineer, the Contractor shall rework the fill until it is approved by the Soils Engineer.

H. Each layer shall be compacted to 90 percent of the maximum density in compliance with the testing method specified by the controlling governmental agency.

If compaction to a lesser percentage is authorized by the controlling governmental agency because of a specific land use or expansive soil conditions, the area to receive fill compacted to less than 90 percent shall either be delineated on the grading plan or appropriate reference made to the area in the soil report.

I. All fills shall be keyed and benched through all topsoil, colluvium, alluvium or creep material, into sound bedrock or firm material where the slope receiving fill exceeds a ratio of five horizontal to one vertical, in accordance with the recommendations of the Soils Engineer.

J. The key for side hill fills shall be a minimum of 15 feet within bedrock or firm materials, unless otherwise specified in the soils report.

K. Drainage terraces and subdrainage devices shall be constructed in compliance with the ordinances of the controlling governmental agency, or with the recommendations of the Soils Engineer.

L. The Contractor will be required to obtain a minimum relative compaction of 90 percent out to the finish slope face of fill slopes. This may be achieved by either overbuilding the slope and cutting back to the compacted core, or by direct compaction of the slope face with suitable equipment, or by any other procedure which produces the required compaction.

If a method other than overbuilding and cutting back to the compacted core is to be employed, slope tests will be made by the Soils Engineer during construction of the slopes to determine if the required compaction is being achieved. Where failing tests occur or other field problems arise, the Contractor will be notified of such conditions by written communication from the Soils Engineer in the form of a conference memorandum, to avoid any misunderstanding arising from oral communication.

If the method of achieving the required slope compaction selected by the Contractor fails to produce the necessary results, the Contractor shall rework or rebuild such slopes until the required degree of compaction is obtained, at no additional cost to the Owner or Soils Engineer.

M. All fill slopes should be planted or protected from erosion by methods specified in the soils report.

N. Fill-over-cut slopes shall be properly keyed through topsoil, colluvium or creep material into rock or firm materials; and the transition shall be stripped of all soil prior to placing fill.

IV. CUT SLOPES

A. If any conditions not anticipated in the preliminary report such as perched water, seepage, lenticular or confined strata of a potentially adverse nature are encountered during grading, these conditions shall be analyzed by the Soils Engineer; and recommendations shall be made to treat these problems.

B. Unless otherwise specified in the soils report, no cut slopes shall be excavated higher or steeper than that allowed by the ordinances of controlling governmental agencies.

C. Drainage terraces shall be constructed in compliance with the ordinances of controlling governmental agencies, or with the recommendations of the Soils Engineer.

V. GRADING CONTROL

A. Inspection of the fill placement shall be provided by the Soils Engineer during the progress of grading.

B. In general, density tests shall be made at intervals not exceeding two feet of fill height of every 500 cubic yards of fill placed. This criteria will vary

depending on soil conditions and the size of the job. In any event, an adequate number of field density tests shall be made to verify that the required compaction is being achieved.

C. Density tests shall also be made on the surface material to receive fill as required by the Soils Engineer.

D. All cleanout, processed ground to receive fill, key excavations, subdrains and rock disposal must be inspected and approved by the Soils Engineer prior to placing any fill. It shall be the Contractor's responsibility to notify the Soils Engineer when such areas are ready for inspection.

VI. CONSTRUCTION CONSIDERATIONS

A. Erosion control measures, when necessary, shall be provided by the Contractor during grading and prior to the completion and construction of permanent drainage controls.

B. Upon completion of grading and termination of inspections by the Soils Engineer, no further filling or excavating, including that necessary for footings, foundations, large tree wells, retaining walls, or other features shall be performed without the approval of the Soils Engineer.

C. Care shall be taken by the Contractor during final grading to preserve any berms, drainage terraces, interceptor swales, or other devices of a permanent nature on or adjacent to the property.

ERNEST K. HIRATA & ASSOC.

BORING LOG

BORING NO. B1 DRIVING WT. 140 lb. DATE OF DRILLING 4-11-73

SURFACE ELEV. 12.0 ± DROP 30 in. W.O. 172

DEPTH FEET	CORE	BAG	PENE. RESIST. BLOWS/6 in.	DRY DENSITY PCF	MOISTURE CONTENT %	RELATIVE COMPACTION %	DIRECT SHEAR STRENGTH PARAMETERS ø	DIRECT SHEAR STRENGTH PARAMETERS C	CLASSIFICATION (% Sand, % Silt, % Clay)
0									FILL - Clayey SILT, Reddish, brown, dry, stiff.
	x		18 24 24	92.4	15.0		18.5°	3.44 KSF	
	x		13 23 30	97.2	16.7				
5									Brick and nail at 5.5 ft.
▽	x		6 6 4	67.9	66.5				Grading moist from 6 ft.
	x		2 2 3	33.9	137.0				Clayey SILT (OL) - Dark gray, wet, soft to firm with organic material.
10									
	x		3 4 3	60.1	67.2				
15									End boring at 15 feet. ▽ Water level at 7 feet.
20									
25									
30									

Plate A1

ERNEST K. HIRATA & ASSOC.

BORING LOG

BORING NO. B2 DRIVING WT. 140 lb. DATE OF DRILLING 4-11-73

SURFACE ELEV. 14.0 ± DROP 30 in. W.O. 172

DEPTH FEET	CORE	BAG	PENE. RESIST. BLOWS/6 in.	DRY DENSITY PCF	MOISTURE CONTENT %	RELATIVE COMPACTION %	DIRECT SHEAR STRENGTH PARAMETERS ø	DIRECT SHEAR STRENGTH PARAMETERS C	CLASSIFICATION (% Sand, % Silt, % Clay)
0									FILL - Clayey SILT, Brown, dry, stiff, some gravel.
	x		24 48	91.4	9.4				
	x		15 14 37		10.0				Cobbles and boulders from 3 feet.
5	x		2 2 2	64.7	57.9				
	x		3 2 2	45.0	93.4		UNCONFINE 639	PSF	Clayey SILT - (OL) - Dark grayish brown, wet, soft to firm, organic.
10									End boring at 10 feet.
15									
20									
25									
30									

Plate A2

ERNEST K. HIRATA & ASSOC.

BORING LOG

BORING NO. B3 DRIVING WT. 140 lb. DATE OF DRILLING 4-11-73

SURFACE ELEV. 19.0 ± DROP 30 in. W.O. 172

DEPTH FEET	CORE	BAG	PENE. RESIST. BLOWS/6 in.	DRY DENSITY PCF	MOISTURE CONTENT %	RELATIVE COMPACTION %	DIRECT SHEAR STRENGTH PARAMETERS ø	DIRECT SHEAR STRENGTH PARAMETERS C	CLASSIFICATION (% Sand, % Silt, % Clay)
0	x		7 6 5						FILL - Silty SAND, Light grayish brown, dry, Dense with gravels
	x		6 4 3	76.2	34.9				Clayey SILT (ML) - Brown, moist, firm.
-5	x		3 2 3	82.8	41.8				Grading soft from 5 feet
▽	x		6 11 22	89.6	34.1				Grading stiff with gravels from 9.5 feet.
-10									End boring at 10 feet. ▽ Water level at 8 feet.
-15									
-20									
-25									
-30									

Plate A3

ERNEST K. HIRATA & ASSOC.

BORING LOG

BORING NO. B4 DRIVING WT. 140 lb. DATE OF DRILLING 4-11-73

SURFACE ELEV. 22.0 ± DROP 30 in. W.O. 172

DEPTH FEET	CORE	BAG	PENE. RESIST. BLOWS/6 in.	DRY DENSITY PCF	MOISTURE CONTENT %	RELATIVE COMPACTION %	DIRECT SHEAR STRENGTH PARAMETERS ø	DIRECT SHEAR STRENGTH PARAMETERS C	CLASSIFICATION (% Sand, % Silt, % Clay)
0									Clayey SILT (MH) - Brown, dry, stiff with sands and gravels. Grading grayish brown from 2 feet.
	x		22 40/3.5"	78.2	29.1				
	x		29/3"		33.2				
5									
	x		18 45	78.1	43.5				
10									
	x		15 31 27	75.6	46.0				
15									End boring at 15 feet.
20									
25									
30									

Plate A4

ERNEST K. HIRATA & ASSOC.

BORING LOG

BORING NO. B5 DRIVING WT. 140 lb. DATE OF DRILLING 4-11-73

SURFACE ELEV. 20.0± DROP 30 in. W.O. 172

DEPTH FEET	CORE	BAG	PENE. RESIST. BLOWS/6 in.	DRY DENSITY PCF	MOISTURE CONTENT %	RELATIVE COMPACTION %	DIRECT SHEAR STRENGTH PARAMETERS ø	DIRECT SHEAR STRENGTH PARAMETERS C	CLASSIFICATION (% Sand, % Silt, % Clay)
0									FILL - Clayey SILT, Brown, slightly moist, stiff with sands and gravels.
	x		34 46/4.5"	77.4	37.3		60°	0.19 KSF	Clayey SILT (ML) - Gray, slightly moist, hard.
5									
	x		20 50	79.1	41.5				Grading brown from 7 ft.
10									
	x		15 35 50	71.9	49.7				
15									End boring at 15 feet.
20									
25									
30									

Plate A5

ERNEST K. HIRATA & ASSOC.

BORING LOG

BORING NO. B6 DRIVING WT. 140 lb. DATE OF DRILLING 4-11-73

SURFACE ELEV. 15.0 ± DROP 30 in. W.O. 172

DEPTH FEET	CORE	BAG	PENE. RESIST. BLOWS/6 in.	DRY DENSITY PCF	MOISTURE CONTENT %	RELATIVE COMPACTION %	DIRECT SHEAR STRENGTH PARAMETERS ø	DIRECT SHEAR STRENGTH PARAMETERS C	CLASSIFICATION (% Sand, % Silt, % Clay)
0	x		4 3 11	93.1	13.2				FILL - Clayey SILT, Reddish brown, slightly moist, firm. Cobbles at 4 feet.
5	x		3 4 3	65.3	68.6		UNCONFINE		Clayey SILT (OL) - Black, wet, soft to firm.
▽							842	PSF	
10	x		3 2 2	51.5	93.2				
15	x		2 1 2	64.3	59.7				
									End boring at 15 feet. ▽ Water level at 7 feet.
20									
25									
30									

Plate A6

ERNEST K. HIRATA & ASSOC.

BORING LOG

BORING NO. B7 DRIVING WT. 140 lb. DATE OF DRILLING 4-11-73

SURFACE ELEV. 14.0 ± DROP 30 in. W.O. 172

DEPTH FEET	CORE	BAG	PENE. RESIST. BLOWS/6 in.	DRY DENSITY PCF	MOISTURE CONTENT %	RELATIVE COMPACTION %	DIRECT SHEAR STRENGTH PARAMETERS ø	DIRECT SHEAR STRENGTH PARAMETERS C	CLASSIFICATION (% Sand, % Silt, % Clay)
0	x		19 40 50/4"	101.2	21.6		58°	0.48 KSF	FILL - Clayey SILT, Reddish brown, moist, stiff to hard
5	x		11 15 14	103.5	26.1				Grading moist at 5 feet.
▽	x		3 3 4	58.2	89.9				Clayey SILT (OL) - Black to grayish brown, wet, soft to firm.
10									End boring at 10 feet. ▽ Water level at 8 feet.
15									
20									
25									
30									

Plate A7

ERNEST K. HIRATA & ASSOC.

BORING LOG

BORING NO. B8 DRIVING WT. 140 lb. DATE OF DRILLING 4-12-73

SURFACE ELEV. 14.0 ± DROP 30 in. W.O. 172

DEPTH FEET	CORE	BAG	PENE. RESIST. BLOWS/6 in.	DRY DENSITY PCF	MOISTURE CONTENT %	RELATIVE COMPACTION %	DIRECT SHEAR STRENGTH PARAMETERS ø	DIRECT SHEAR STRENGTH PARAMETERS C	CLASSIFICATION (% Sand, % Silt, % Clay)
0									FILL - Clayey SILT, Reddish brown, moist, medium stiff.
	x		10 9 6	77.6	27.2				
5	x		27 44 24/1"						Cobble at 6 feet.
▽									Silty SAND (SM) - Gray, very wet, loose to medium dense.
	x		2 2 2	37.9	139.2				Clayey SILT (OL) - Black, wet, soft to firm.
10									
	x		4 3 5	60.1	68.8				
15									End boring at 15 feet. ▽ Water level at 9 feet.
20									
25									
30									

Plate A8

ERNEST K. HIRATA & ASSOC.

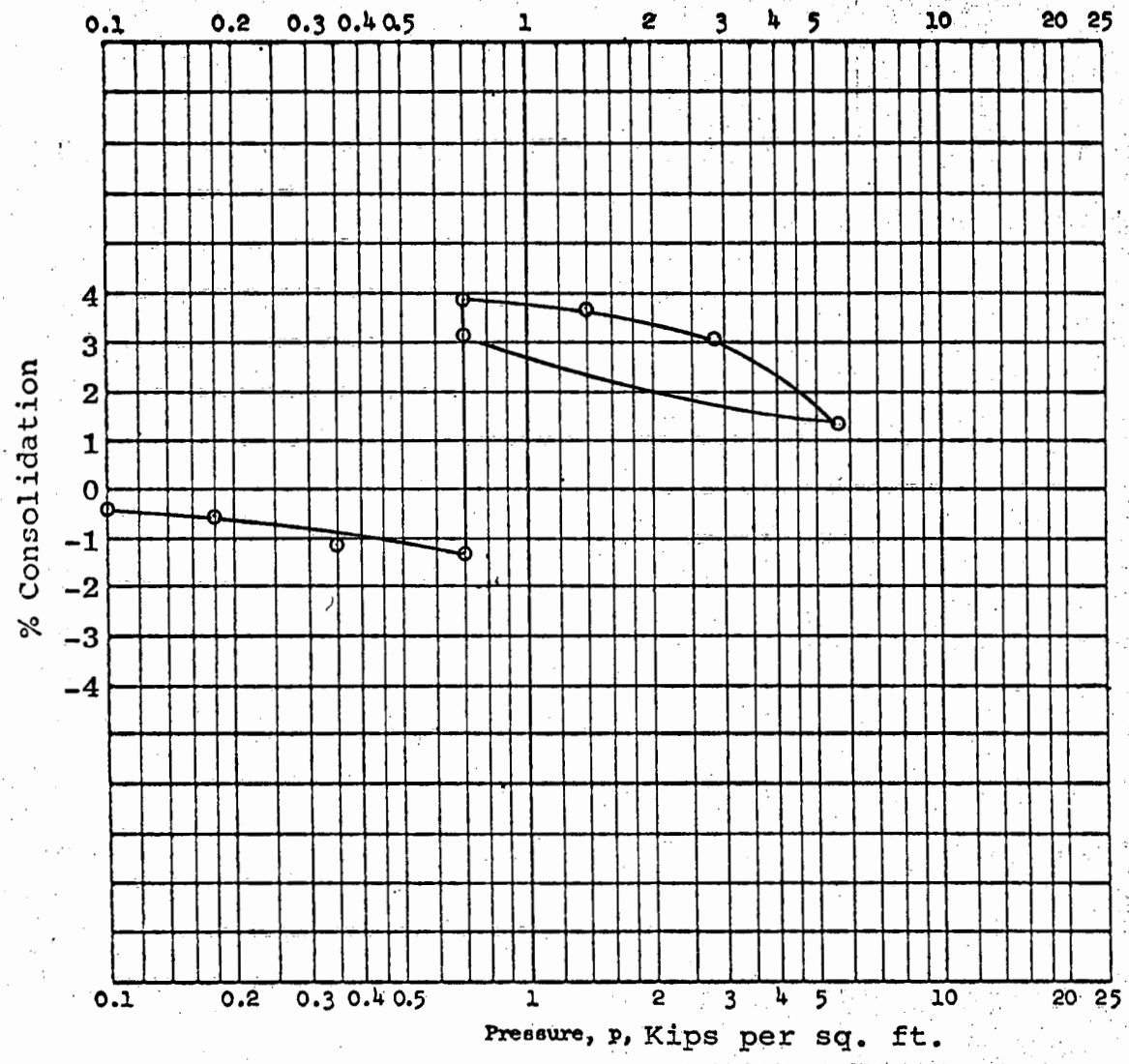
BORING LOG

BORING NO. B9 DRIVING WT. 140 lb. DATE OF DRILLING 4-12-73

SURFACE ELEV. 15.0 ± DROP 30 in. W.O. 172

DEPTH FEET	CORE	BAG	PENE. RESIST. BLOWS/6 in.	DRY DENSITY PCF	MOISTURE CONTENT %	RELATIVE COMPACTION %	DIRECT SHEAR STRENGTH PARAMETERS Ø	DIRECT SHEAR STRENGTH PARAMETERS C	CLASSIFICATION (% Sand, % Silt, % Clay)
0									FILL - Clayey SILT, Reddish brown, slightly moist, stiff with cobbles.
	x		11 22 40	85.3	21.0				
5	x		12 24 19	96.8	15.1				Boulders at 7 feet.
	x		10 9						
10			5						Clayey SILT (OL) - Black, wet, soft to firm.
									End boring at 10 feet.
15									
20									
25									
30									

Plate A9



Type of Specimen Undisturbed		Before Test		After Test	
Diam 2.40 in.	Ht 1.0 in.	Water Content, w_o	16.7 %	w_f	33.3 %
Overburden Pressure, p_o T/sq ft		Void Ratio, e_o		e_f	
Preconsol. Pressure, p_c T/sq ft		Saturation, S_o	%	S_f	%
Compression Index, C_c		Dry Density, γ_d	92.2 lb/ft^3		
Classification		k_{20} at e_o =	× 10$^-$ cm/sec		
LL	G_s	Project Waipahu Nani Subdivision			
PL	D_{10}	Waipio, Ewa			
Remarks Water added at 700 PSF		Area W.O. 172			
		Boring No. B1		Sample No.	
		Depth El 4'		Date 4-11-73	
		CONSOLIDATION TEST REPORT			

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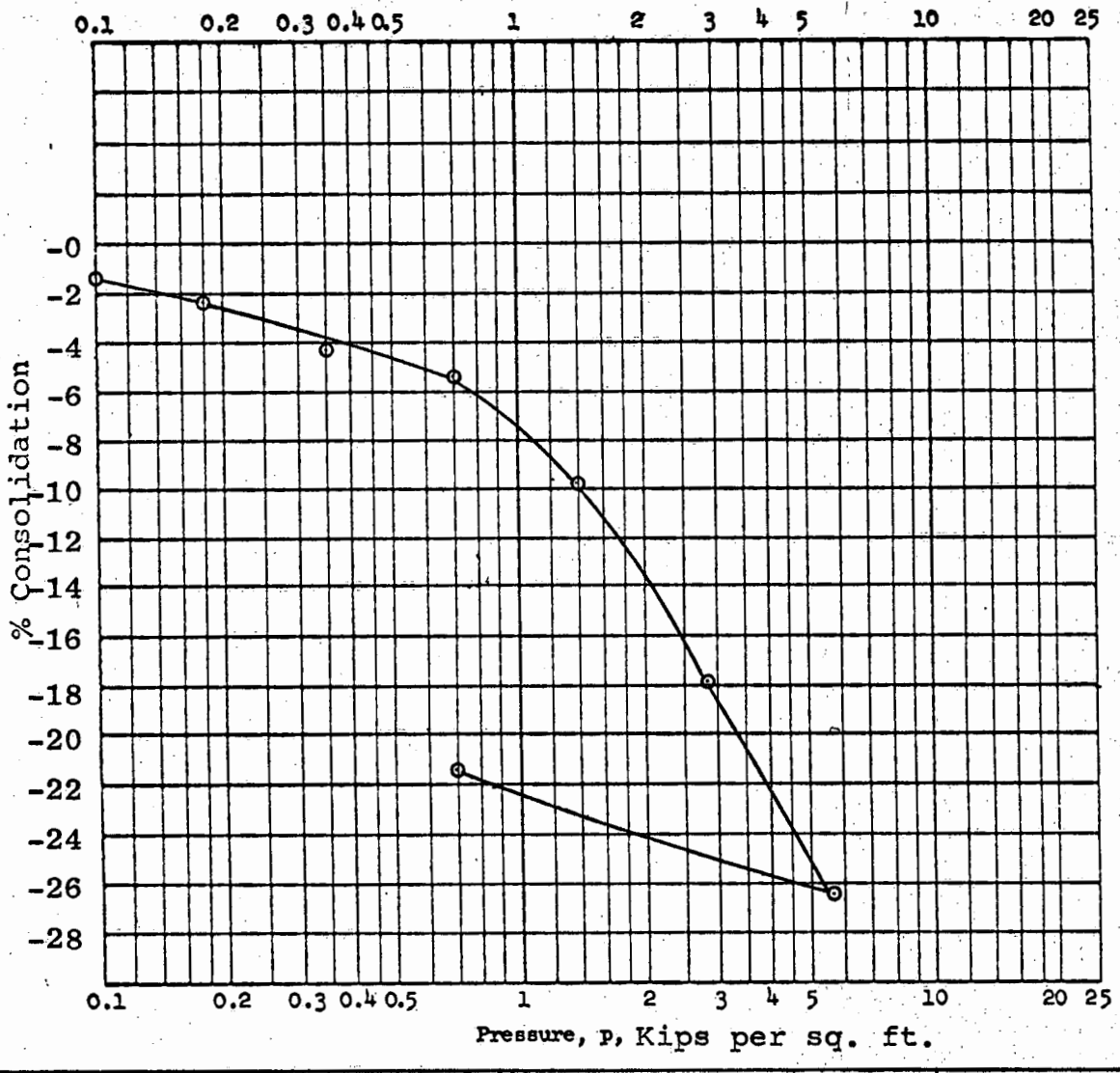
Plate B1



Type of Specimen: Undisturbed		Before Test		After Test	
Diam 2.40 in.	Ht 1.0 in.	Water Content, w_o	137.0 %	w_f	127.8 %
Overburden Pressure, p_o T/sq ft		Void Ratio, e_o		e_f	
Preconsol. Pressure, p_c T/sq ft		Saturation, S_o	%	S_f	%
Compression Index, C_c		Dry Density, γ_d	33.9 lb/ft^3		
Classification		k_{20} at e_o =	× 10^{-} cm/sec		
LL	G_s	Project: Waipahu Nani Subdivision			
PL	D_{10}	Waipio, Ewa			
Remarks: Water added at 700 PSF		Area: W.O. 172			
		Boring No. B1		Sample No.	
		Depth El 8.5'		Date 4-11-73	
		CONSOLIDATION TEST REPORT			

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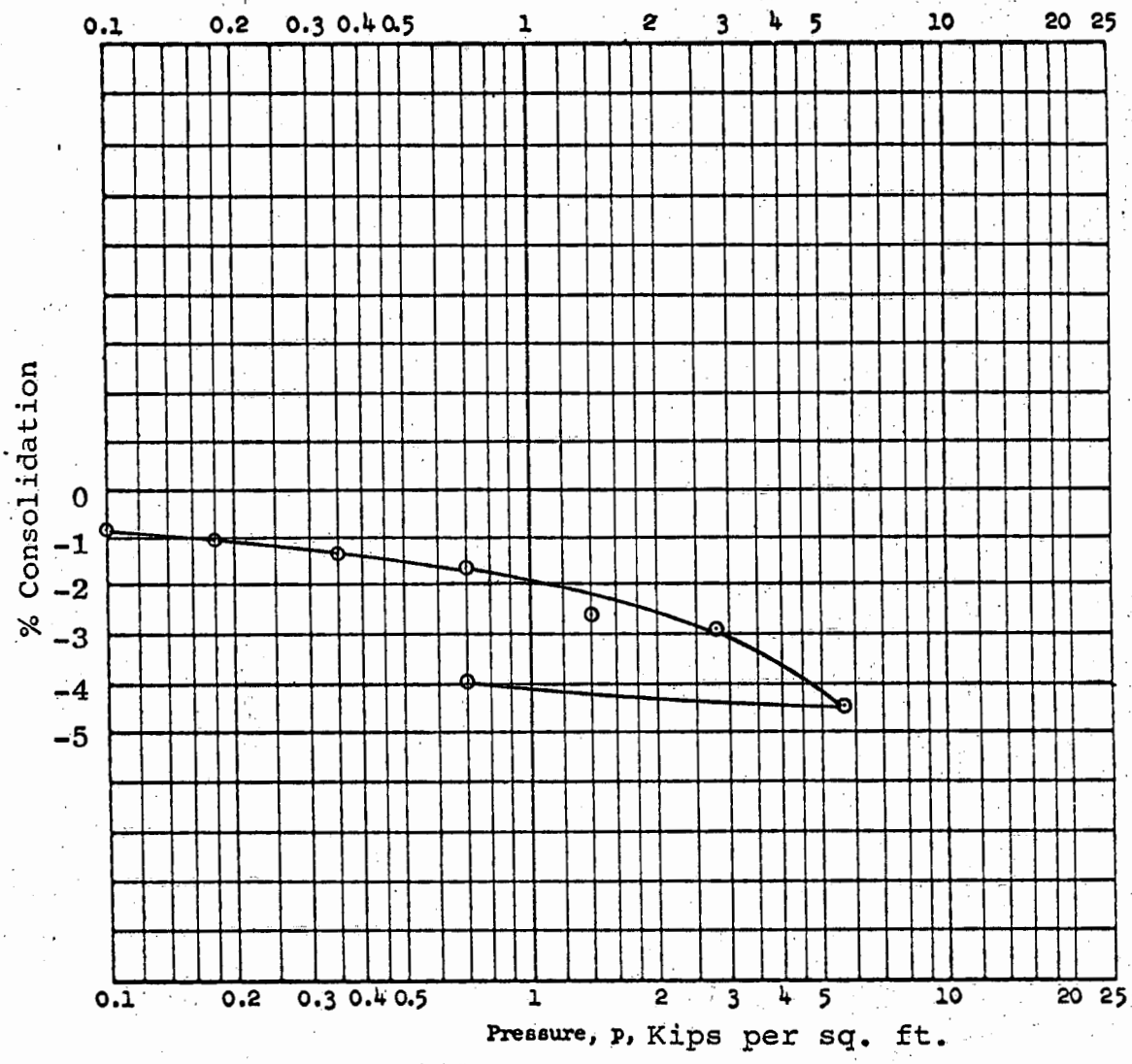
Plate B2

0 3424



Type of Specimen: Undisturbed		Before Test		After Test	
Diam 2.40 in.	Ht 1.0 in.	Water Content, w_o	34.9 %	w_f	30.0 %
Overburden Pressure, p_o T/sq ft		Void Ratio, e_o		e_f	
Preconsol. Pressure, p_c T/sq ft		Saturation, S_o	%	S_f	%
Compression Index, C_c		Dry Density, γ_d	76.2 lb/ft^3		
Classification		k_{20} at e_o =	× 10$^-$ cm/sec		
LL	G_s	Project: Waipahu Nani Subdivision			
PL	D_{10}	Waipio, Ewa			
Remarks: Water added at 700		Area: W.O. 172			
PSF		Boring No. B3		Sample No.	
		Depth / El 4'		Date 4-15-73	
		CONSOLIDATION TEST REPORT			

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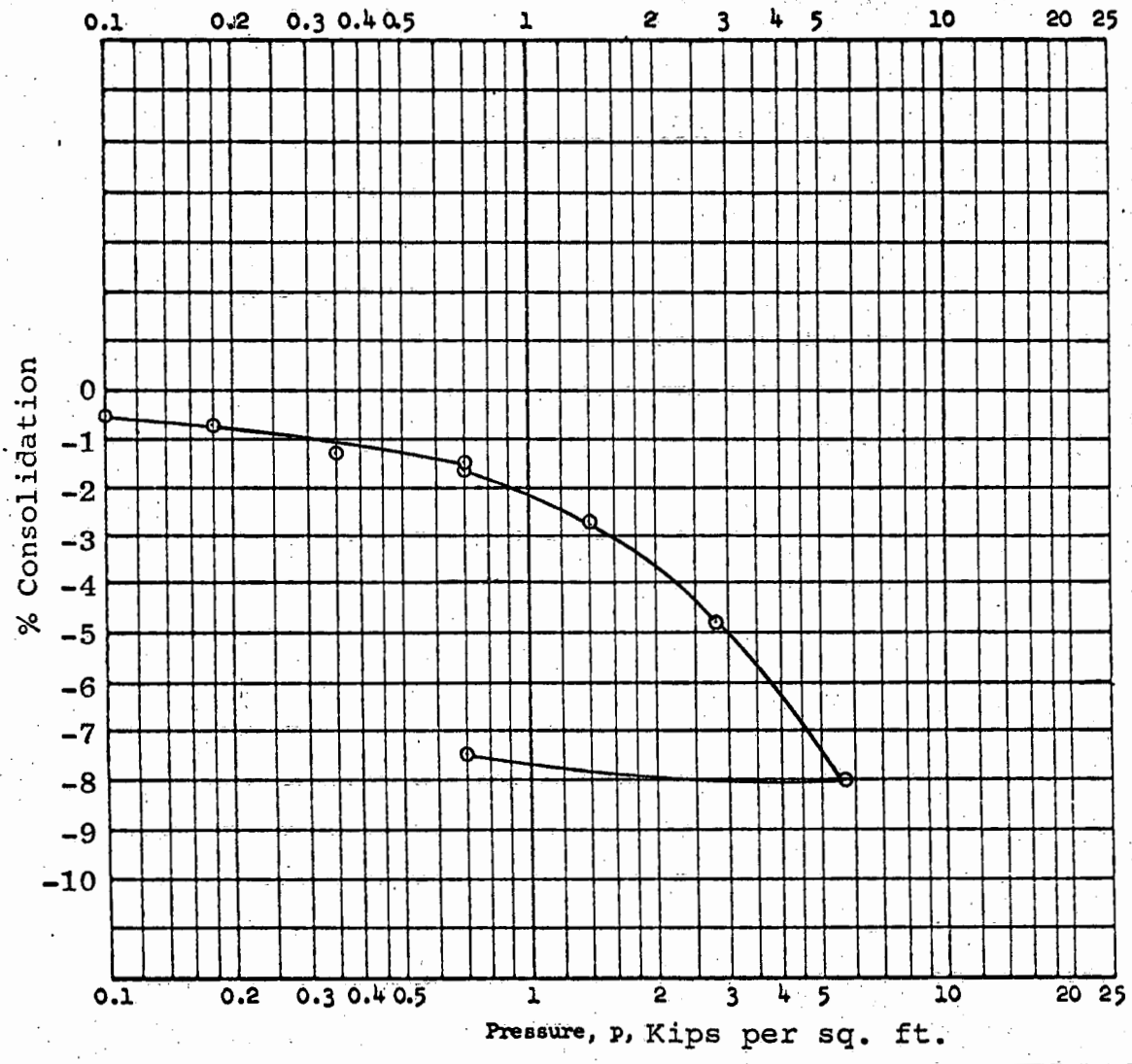
Plate B3

0 3424



Type of Specimen: Undisturbed		Before Test		After Test	
Diam 2.40 in.	Ht 1.0 in.	Water Content, w_o	13.2 %	w_f	32.9 %
Overburden Pressure, p_o T/sq ft		Void Ratio, e_o		e_f	
Preconsol. Pressure, p_c T/sq ft		Saturation, S_o	%	S_f	%
Compression Index, C_c		Dry Density, γ_d	93.1 lb/ft^3		
Classification		k_{20} at e_o =	× 10$^-$ cm/sec		
LL	G_s	Project	Waipahu Nani Subdivision		
PL	D_{10}		Waipio, Ewa		
Remarks: Water added at 700		Area	W.O. 172		
PSF		Boring No.	B6	Sample No.	
		Depth El	3'	Date	4-17-73
		CONSOLIDATION TEST REPORT			

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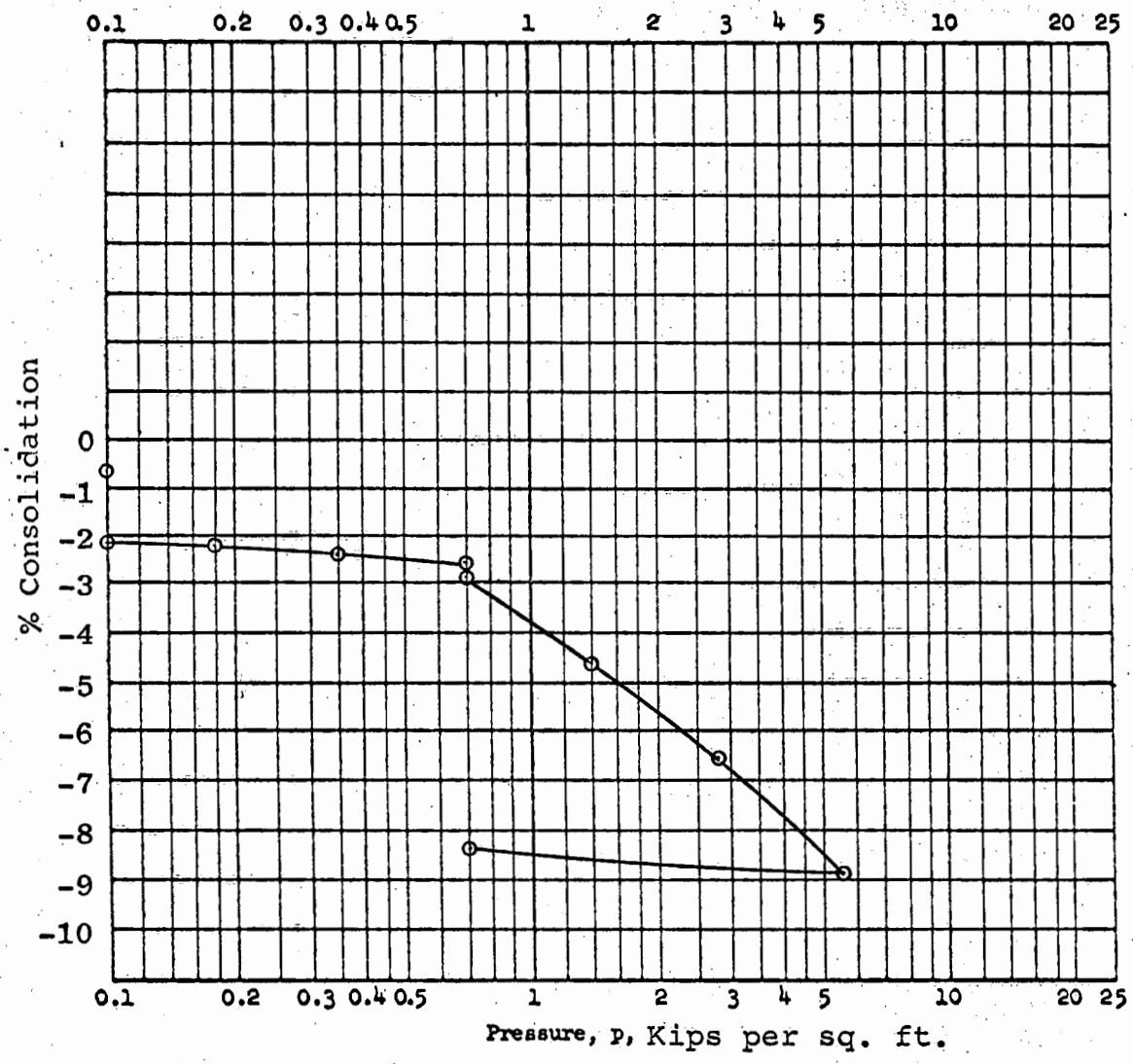
Plate B4

0 3424



Type of Specimen Undisturbed		Before Test		After Test	
Diam 2.40 in.	Ht 1.0 in.	Water Content, w_o	68.6 %	w_f	30.8 %
Overburden Pressure, p_o T/sq ft		Void Ratio, e_o		e_f	
Preconsol. Pressure, p_c T/sq ft		Saturation, S_o	%	S_f	%
Compression Index, C_c		Dry Density, γ_d	65.3 lb/ft^3		
Classification		k_{20} at e_o =	× 10$^-$ cm/sec		
LL	G_s	Project Waipahu Nani Subdivision			
PL	D_{10}	Waipio, Ewa			
Remarks Water added at 700		Area W.O. 172			
PSF		Boring No. B6		Sample No.	
		Depth El 6'		Date 4-13-73	
		CONSOLIDATION TEST REPORT			

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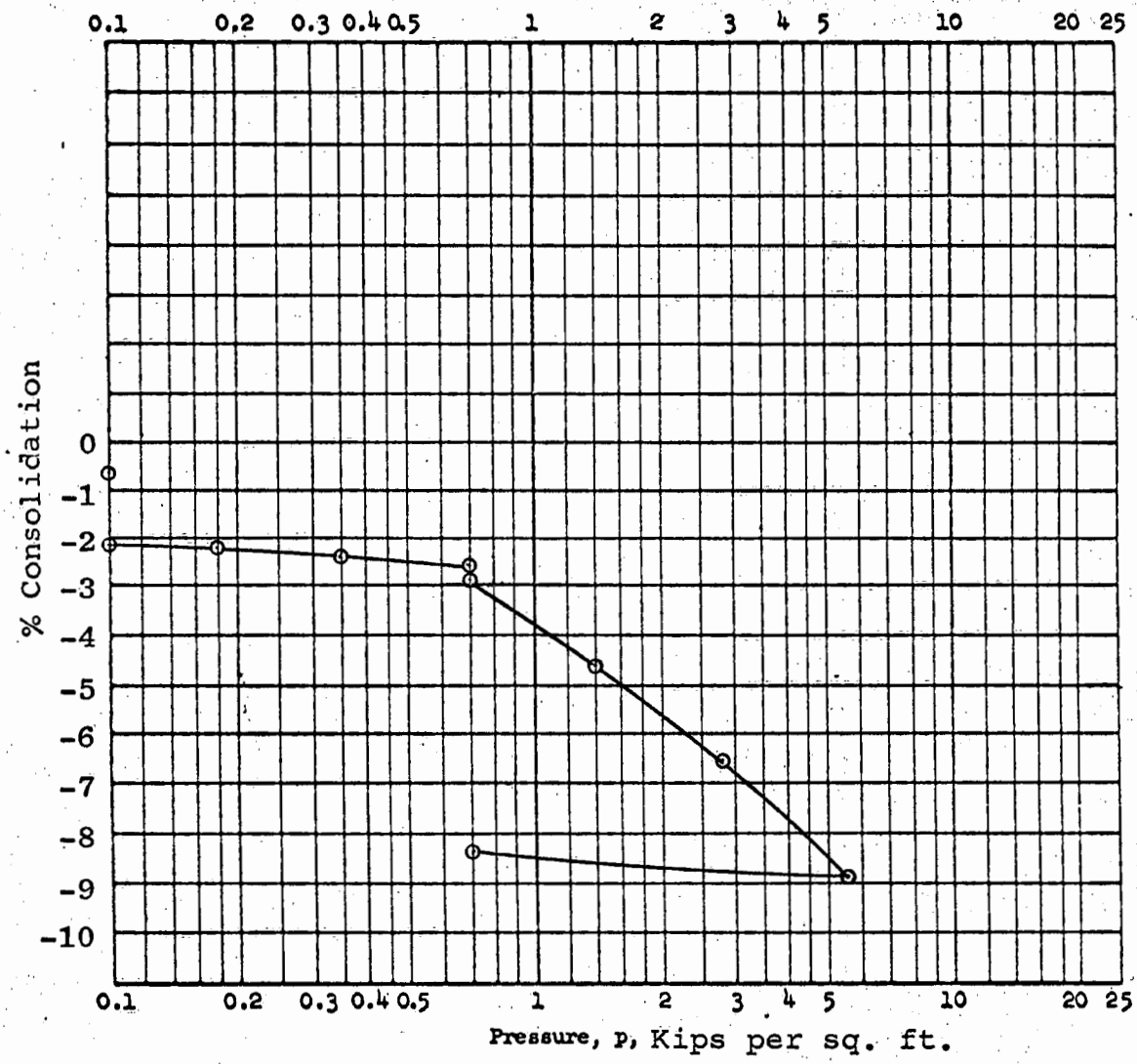
Plate B5

0 3424



Type of Specimen Undisturbed		Before Test		After Test	
Diam 2.40 in.	Ht 1.0 in.	Water Content, w_o	68.6 %	w_f	30.8 %
Overburden Pressure, p_o T/sq ft		Void Ratio, e_o		e_f	
Preconsol. Pressure, p_c T/sq ft		Saturation, S_o	%	S_f	%
Compression Index, C_c		Dry Density, γ_d	65.3 lb/ft^3		
Classification		k_{20} at e_o =	× 10$^-$ cm/sec		
LL	G_s	Project Waipahu Nani Subdivision			
PL	D_{10}	Waipio, Ewa			
Remarks Water added at 700		Area W.O. 172			
PSF		Boring No. B6		Sample No.	
		Depth El 6'		Date 4-13-73	
		CONSOLIDATION TEST REPORT			

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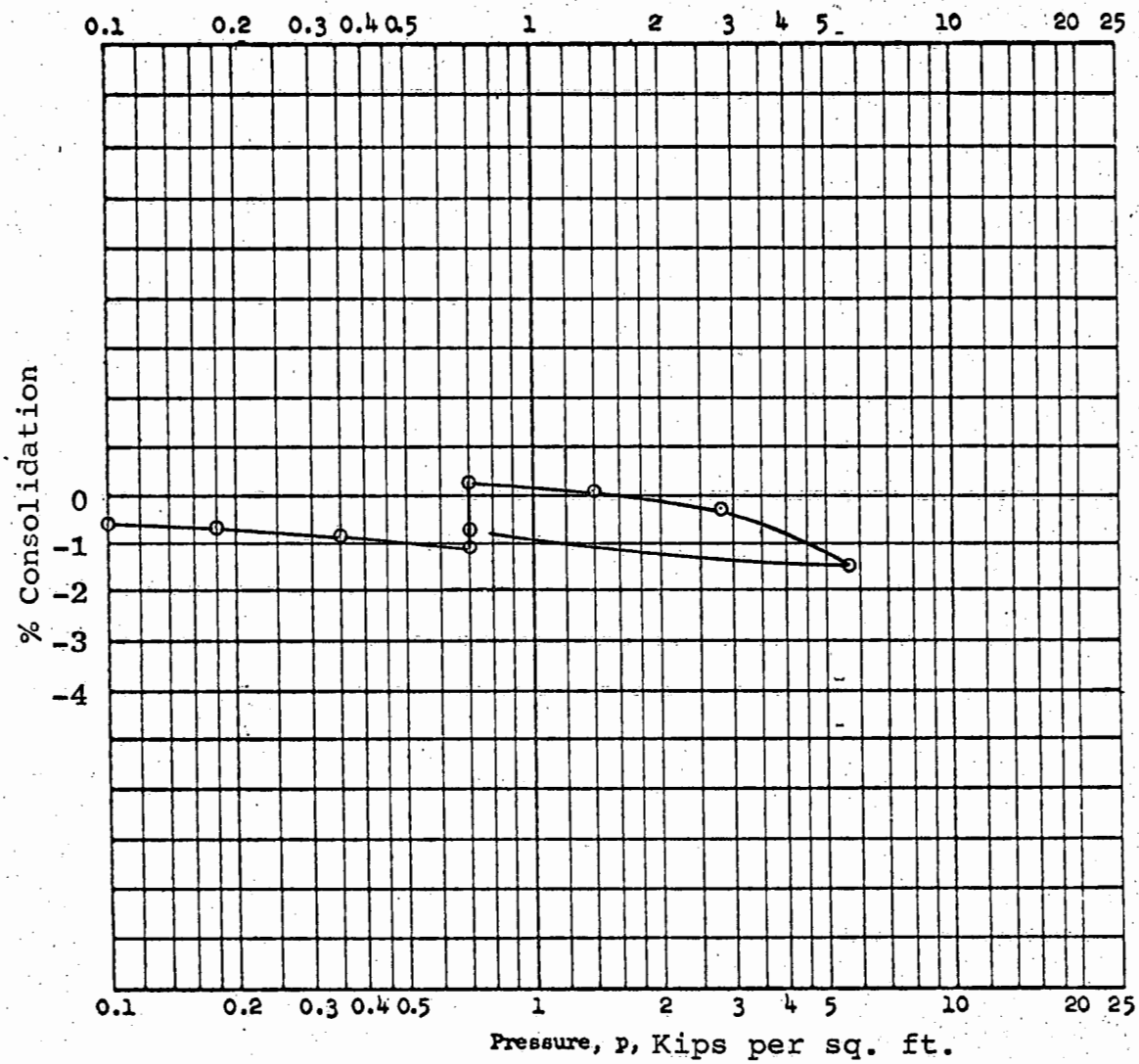
Plate B5

0 3424



Type of Specimen	Undisturbed	Before Test		After Test	
Diam 2.40 in.	Ht 1.0 in.	Water Content, w_o	26.1 %	w_f	30.2 %
Overburden Pressure, p_o T/sq ft		Void Ratio, e_o		e_f	
Preconsol. Pressure, p_c T/sq ft		Saturation, S_o	%	S_f	%
Compression Index, C_c		Dry Density, γ_d	103.5 lb/ft^3		
Classification		k_{20} at e_o =	× 10$^-$ cm/sec		
LL	G_s	Project	Waipahu Nani Subdivision		
PL	D_{10}		Waipio, Ewa		
Remarks	Water added at 700 PSF	Area	W.O. 172		
		Boring No.	B7	Sample No.	
		Depth El	5'	Date	4-17-73

CONSOLIDATION TEST REPORT

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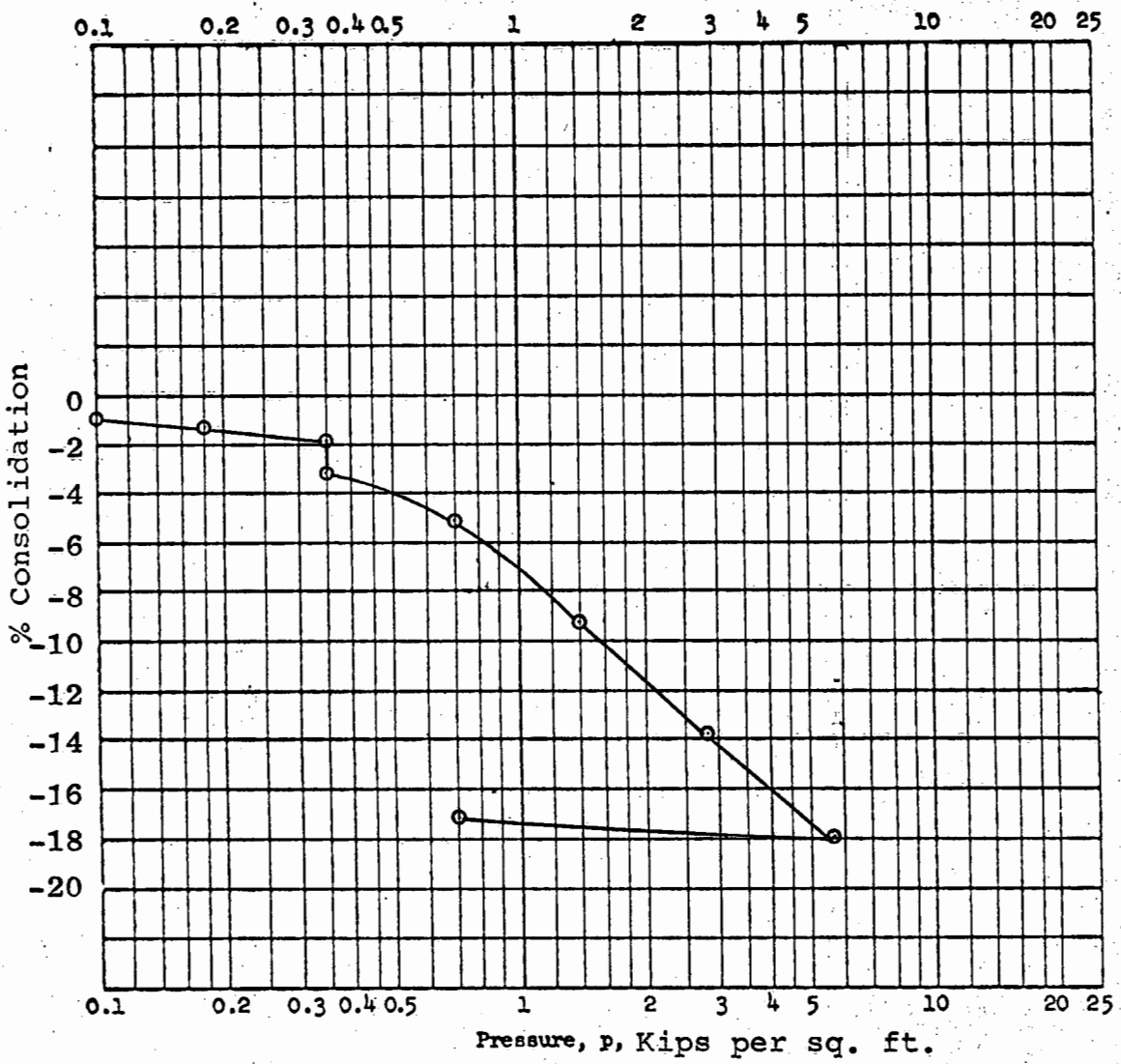
Plate B6



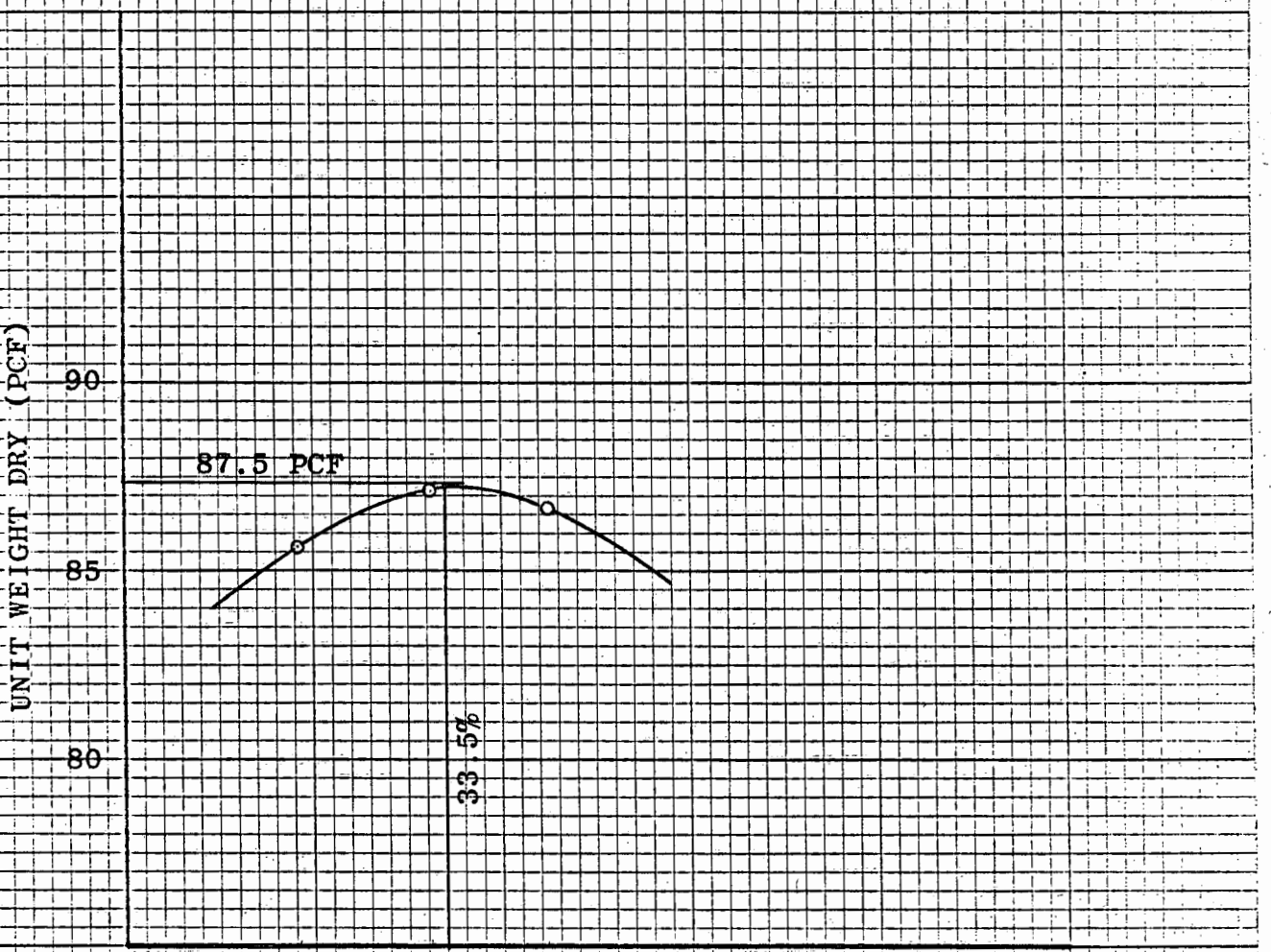
Type of Specimen: Undisturbed		Before Test		After Test	
Diam 2.40 in.	Ht 1.0 in.	Water Content, w_o	27.2 %	w_f	31.8 %
Overburden Pressure, p_o T/sq ft		Void Ratio, e_o		e_f	
Preconsol. Pressure, p_c T/sq ft		Saturation, S_o	%	S_f	%
Compression Index, C_c		Dry Density, γ_d	77.6 lb/ft^3		
Classification		k_{20} at e_o =	× 10$^-$ cm/sec		
LL	G_s	Project: Waipahu Nani Subdivision			
PL	D_{10}	Waipio, Ewa			
Remarks: Water added at 350 PSF		Area: W.O. 172			
		Boring No. B8		Sample No.	
		Depth / El 3'		Date 4-19-73	
		CONSOLIDATION TEST REPORT			

ENG FORM 2090
1 MAY 63

Plate B7

0 3424

MAXIMUM DENSITY CURVE



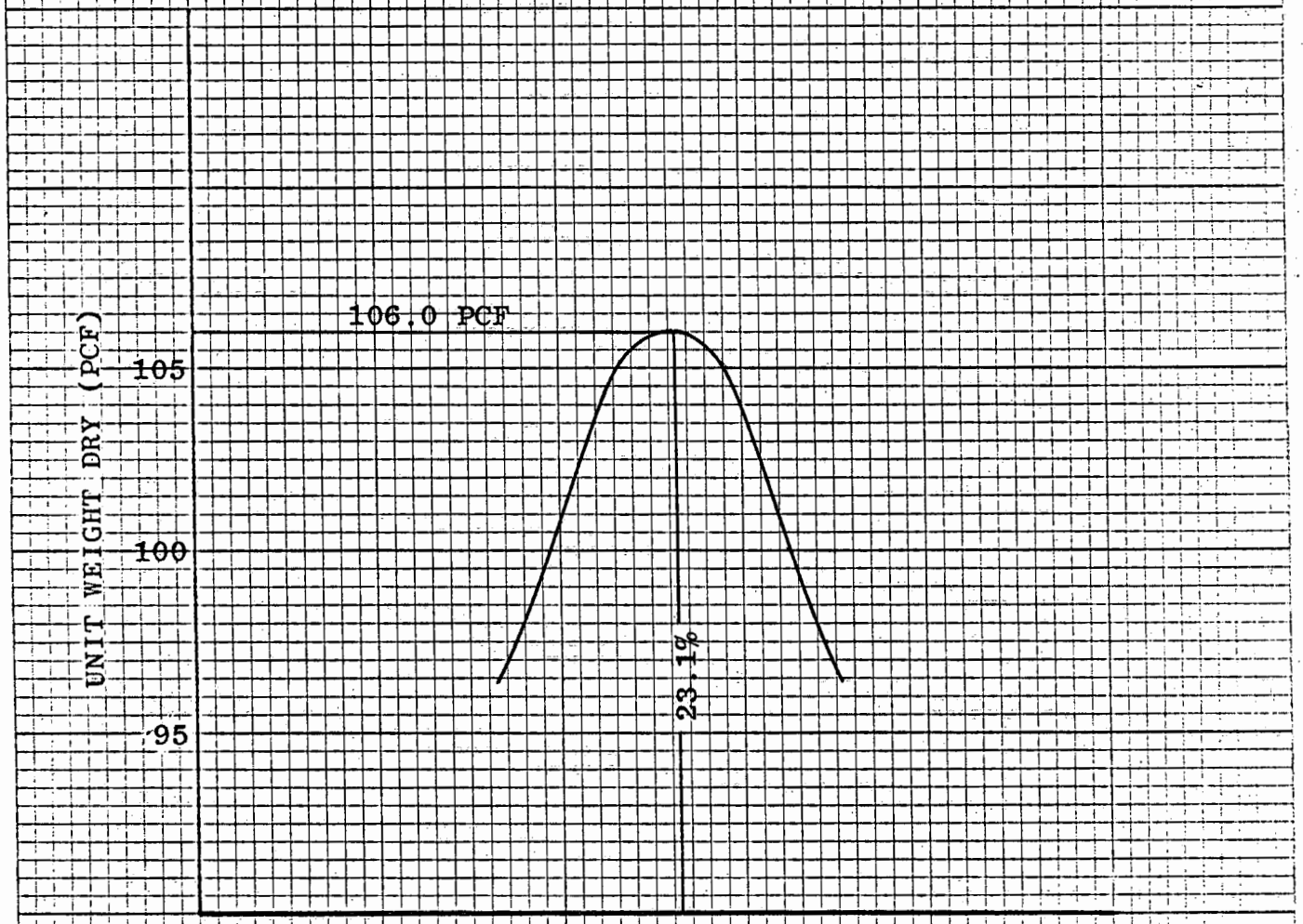
Boring: B4

Depth: 5' - 13'

Classification: MH W.O. 172

L.L.= 56.4
P.L.= 49.6
P.I.= 6.8

MAXIMUM DENSITY CURVE

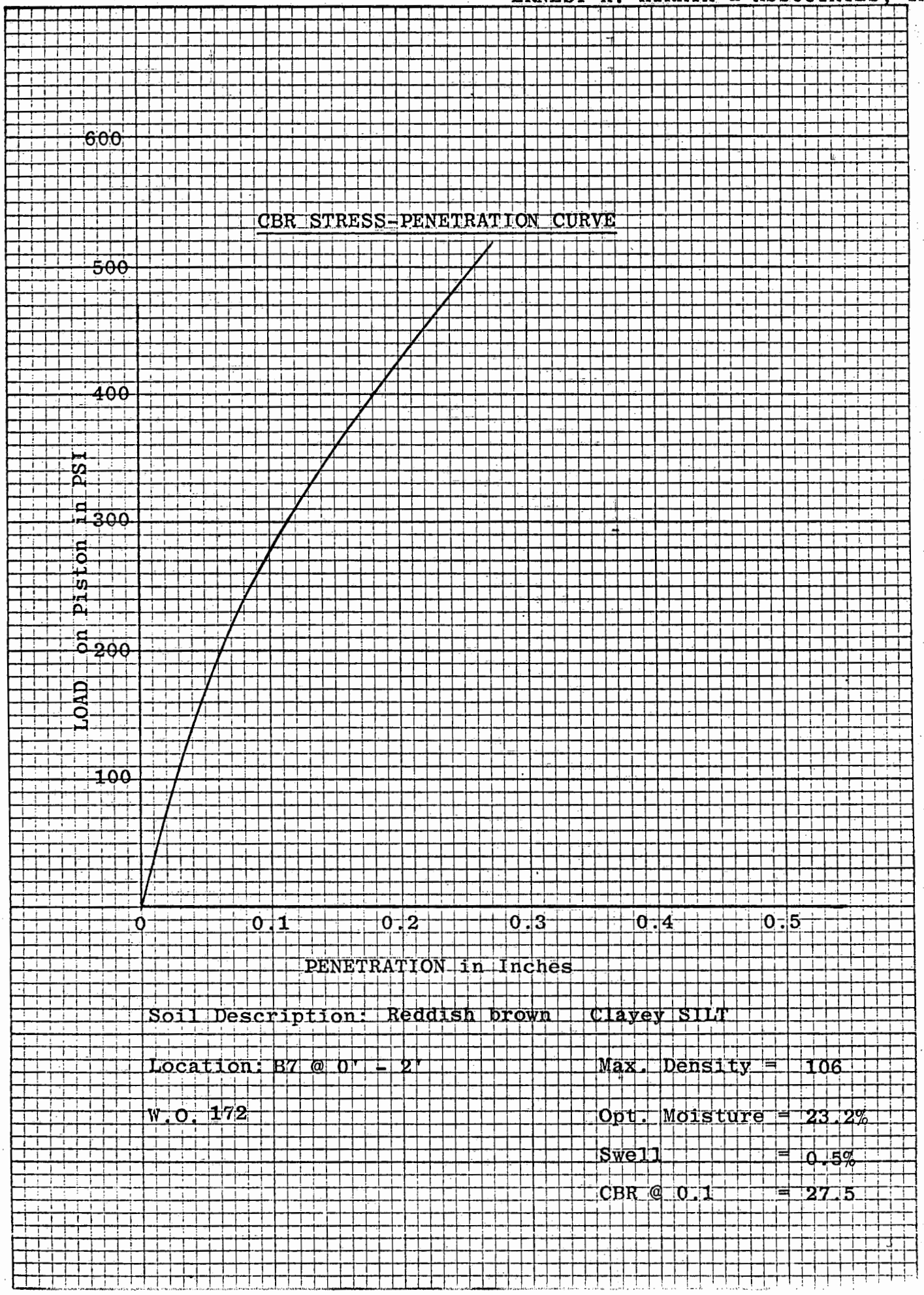


Boring: B7

Depth: 0' - 2'

Classification: ML W.O. 172

L.L. = 38.0
P.L. = 28.4
P.I. = 9.6



Soil Description: Reddish brown Clayey SILT

Location: B7 @ 0' - 2'

W.O. 172

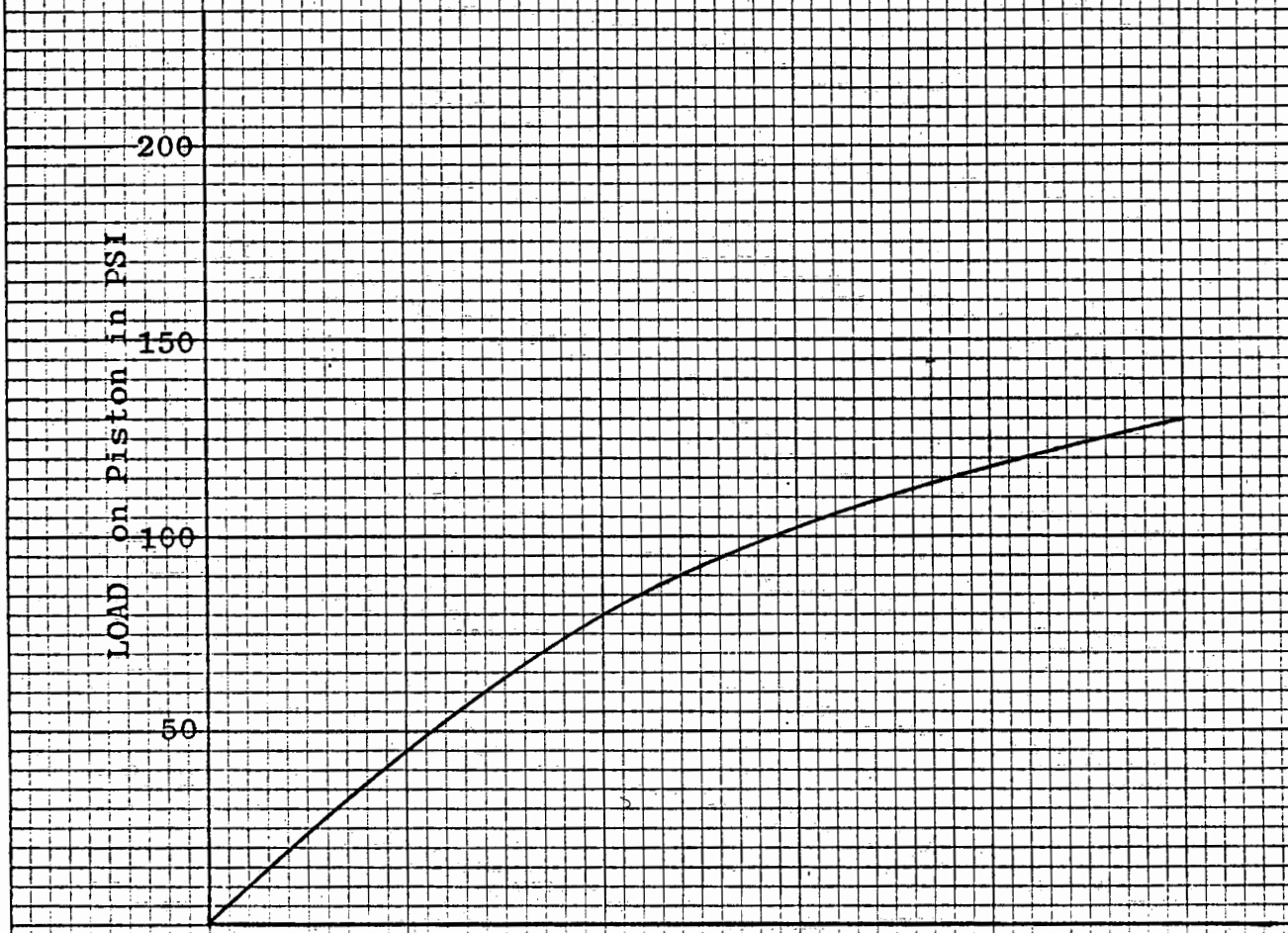
Max. Density = 106

Opt. Moisture = 23.2%

Swell = 0.5%

CBR @ 0.1 = 27.5

CBR STRESS-PENETRATION CURVE



Soil Description: Brown Clayey SILT

Location: B4 @ 5' -13'

W.O. 172

Max. Density = 87.5

Opt. Moisture = 33.5

Swell = 4.16%

CBR @ 0.1 = 4.5

LABORATORY TEST RESULTS

Project: Waipahu Nani Subdivision **W.O.** 172

Boring or Test Pit No.		B2	B3	B4	B6	B7
Depth (ft.)		8.5	4'	5'-13'	6	0-2'
Atterburg Limit Tests						
Liquid Limit				56.4		38.0
Plastic Limit				49.6		28.4
Plastic Index				6.8		9.6
Soil Classification		OL	ML	MH	OL	ML
Expansion @ 90 PSF						
Natural						
Remolded						2.04
Expansion @ 700 PSF						
Natural			0			
Remolded						
Unconfine Stress (PSF)		639			842	
Proctor						
Max. Dry Unit Wt. (PCF)				87.5		106.0
Optimum Water (%)				33.5		23.2
Wet Density In-Place (PCF)		87.0	102.7		110.2	
Moisture In-Place (%)		93.4	34.9		68.6	
Dry Unit Wt. In-Place (PCF)		45.0	76.2		65.3	
Remolded Shear	ø					65.5
	C					0.67° KSF

Plate E

LIMITATIONS

The boring logs indicate the approximate subsurface soil conditions encountered only at those locations where the borings were made and may not represent conditions at other locations.

During construction, should subsurface conditions differ from those encountered in the borings, we should be advised immediately in order to review and to revise our recommendations.

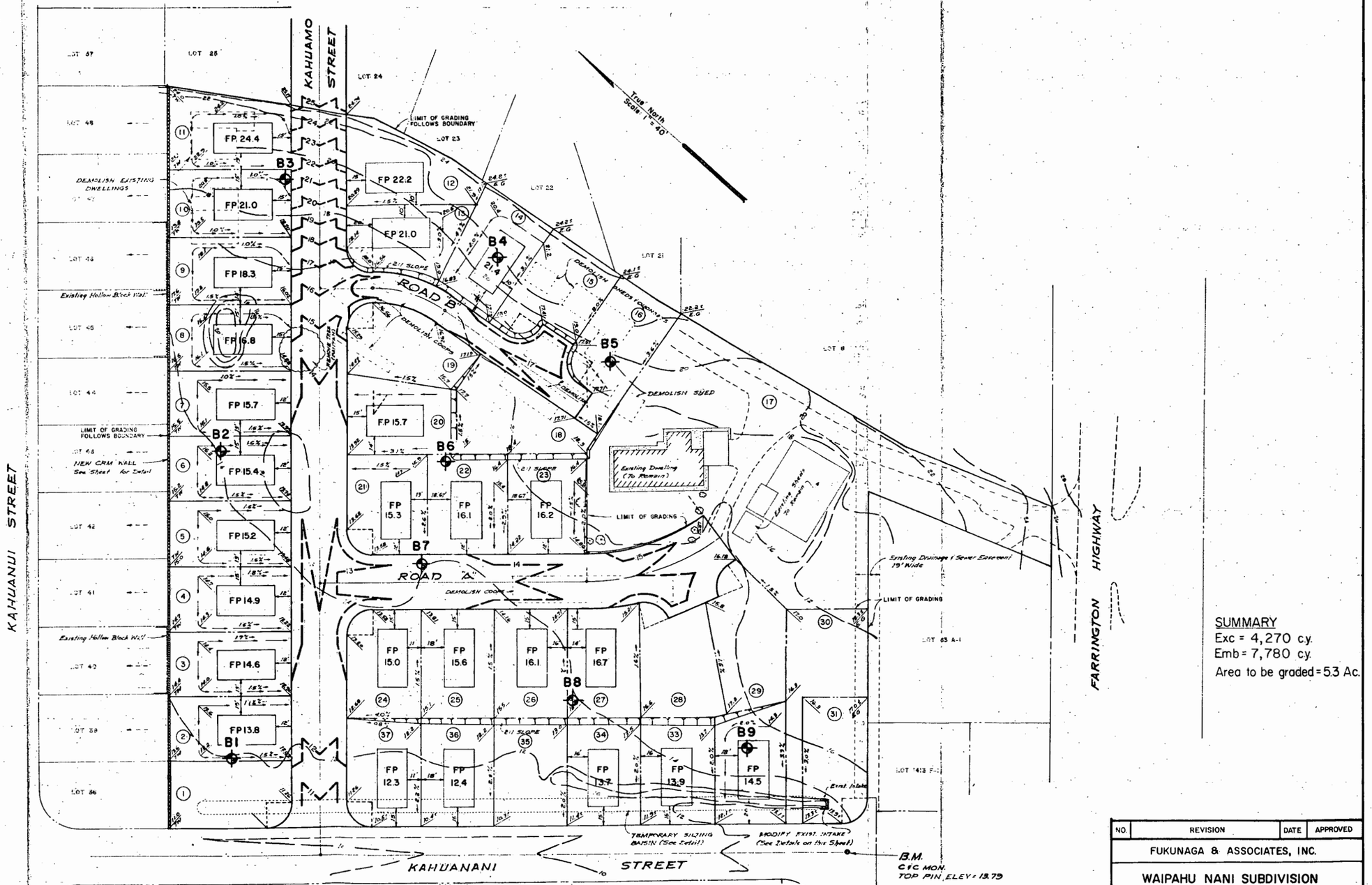
Our professional services were performed, findings obtained, and recommendations prepared in accordance with generally accepted engineering practices. This warranty is in lieu of all other warranties expressed or implied.

GRADING NOTES

1. All grading work shall conform to Chapter 23, Revised Ordinances of Honolulu 1969, as amended. (Ordinance No. 3968)
2. The Contractor shall remove all silt and debris resulting from his work and deposited in drainage facilities, roadways, and other areas. The costs incurred for any remedial action by the Chief Engineer shall be payable by the Contractor.
3. The Contractor, at his own expense, shall keep the project area and surrounding area free from dust nuisance. The work shall be in conformance with the air pollution control standards and regulations of the State Department of Health.
4. All grading operations shall be performed in conformance with the applicable provisions of the Water Pollution Control and Water Quality Standards contained in the Public Health Regulations, State Department of Health, on Water Pollution Control and Water Quality Standards.
5. All slopes and exposed areas shall be sodded or planted immediately after the grading work has been completed.
6. Fills on slopes steeper than 5:1 shall be keyed.
7. The City shall be informed of the location of the disposal site for the excess material from the project when the application for a grading permit is made. The disposal site must also fulfill the requirements of the grading ordinance.
8. The City shall be informed of the location of the borrow site for the borrow required for this project when the application for a grading permit is made. The borrow site must also fulfill the requirements of the grading ordinance.
9. Prior to the issuance of a grading permit, the permittee shall obtain a certification by the State Department of Health on the acceptability of the proposed erosion control.
10. No grading work shall be done on Saturdays, Sundays, and holidays at any time without prior notice to the Chief Engineer.
11. All grading work shall also conform to the requirements set forth in the Engineer's report on soil investigation dated , by Ernest K. Hirata & Associates, Inc.
12. Maximum cut and fill slopes shall be 2 Horizontal to 1 Vertical (2:1).

LEGEND

- 16 — Existing Contour
- 16 — Finish Contour
- 14.8 — Finish Spot Elevation (E.G.- Existing Ground Elev.)
- 14.8 / 14.6 — Top Wall Elevation
- 15% — Swale Flow Line and Slope
- FP 15.7 — 24' x 46' Pad for Future Concrete Slab (only where shown on plans) and Finish Pad Elevation (FP).
- (23) — Lot Number



SUMMARY
Exc = 4,270 c.y.
Emb = 7,780 c.y.
Area to be graded = 5.3 Ac.

GRADING PLAN
SCALE: 1" = 40'

⊕ Approx. location of borings

ERNEST K. HIRATA & ASSOCIATES, INC.
Soils and Foundation Engineering
1137 South King Street Honolulu, Hawaii

Date April 23, 1973 W.O. 172

THIS WORK WAS PREPARED BY ME OR UNDER MY SUPERVISION

NO.	REVISION	DATE	APPROVED

FUKUNAGA & ASSOCIATES, INC.

WAIPAHU NANI SUBDIVISION
AT WAIPIO, EWA, OAHU, HAWAII

GRADING PLAN

APPROVED
CHIEF, DIVISION OF ENGINEERING

SHEET OF SHEETS